DETECTOR CONSTRUCTED FROM FABRIC

FIELD OF THE INVENTION

The present invention relates to a detector constructed from fabric having electrically conductive elements to define at least two electrically conductive planes.

INTRODUCTION TO THE INVENTION

A fabric touch sensor for providing positional information is described in U.S. Pat. No. 4,659,873 of Gibson. The sensor is fabricated using at least one resistive fabric layer in the form of conducting threads. This fabric is constructed using either uni-directional threads or crossed threads formed by overlaying one set with another or weaving the two sets together. The fabric is separated from a second resistive layer to prevent unintentional contact by separators in the form of non-conducting threads, insulator dots or with an air gap. Both resistive layers are fabrics formed from conductive threads such that no pre-forming is required in order to adapt the sensor to a contoured object.

A problem with the sensor described in the aforesaid United States patent is that it is only capable of identifying the location of the mechanical interaction and cannot provide additional information about the interaction.

A touch sensor for providing positional information is described in U.S. Pat. No. 4,487,885 of Talmage, which also provides a signal dependent upon the pressure or force applied. However, the sensor described is made from a printed circuit board and a flexible sheet of rubber, elastomer or plastic and as such it does not have the many physical qualities that a fabric may provide.

An improvement to this proposal is disclosed in the applicant's copending British patent application number 98 20 902.6 in which there is provided a position detector constructed from fabric having electrically conductive elements, comprising at least two electrically conductive planes. A potential is applied across at least one of the planes to determine the position of a mechanical interaction. In addition, a second electrical property is determined, such as current, to identify additional properties of the mechanical interaction, such as an applied force, an applied pressure or an area of contact.

The position detector, constructed from fabric, facilitates bending and folding operations. However, a problem with the disclosed construction is that the electrical characteristics of the detector are unreliable if the detector planes are folded or distorted beyond modest operational conditions. Certain folding or bending of the sensor can cause pressures within the fabric similar in magnitude to those pressures desired to be measured, leading to undesirable output response characteristics.

A further limitation of the aforementioned disclosures, is that switching arrangements employed to perform position detection may result in undesirable radio frequency emissions. In the particular case of a fabric position detector, It may be desirable to have the fabric in close proximity to an operator, possibly being worn as an article of clothing. Under these circumstances, radio frequency emissions must be kept to a level that may not be achievable using the disclosed detector arrangements.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a method of detecting the position of a mechanical interaction in a sensor constructed from fabric, wherein a substantially

constant electric current is established through said elements, including steps of measuring a first electrical potential developed in a first plane in response to said current; measuring a second electrical potential developed in a second plane in response to said current; and processing said measurements to identify a position of said mechanical interaction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a position detector constructed from fabric, including outer planes, a central layer and a control circuit;

FIG. **2** shows the control circuit identified in FIG. **1**;

FIG. **3** details operations performed by the microcontroller identified in FIG. **2**;

FIG. **4** details construction of the outer planes and central layer shown in FIG. **1**;

FIG. **5**A details current flow in the sensor shown in FIG. **4**, in a first mode of measurement;

FIG. **5**B details current flow in the sensor shown in FIG. **4**, in a second mode of measurement;

FIG. **6** details a schematic representation of current flowing in the sensor arrangement shown in FIG. **1**, in response to signals issued by the circuit shown in FIG. **2**;

FIG. **7** details a cross sectional view of the type of sensor shown in FIG. **4** under conditions of folding, creasing and deliberate applied force;

FIG. **8** details a cross sectional view of an alternative sensor construction under conditions of folding, creasing and deliberate applied force;

FIG. **9** illustrates physical and electrical characteristics of the sensor shown in FIG. **7**;

FIG. **10** illustrates physical and electrical characteristics of the sensor shown in FIG. **8**;

FIG. **11** illustrates physical and electrical characteristics of a composite sensor comprising the sensors shown in FIGS. **7** and **8**;

FIG. **12** details a cross sectional view of an further alternative sensor construction under conditions of folding, creasing and deliberate applied force;

FIG. **13** details a cross sectional view of a further alternative sensor construction under conditions of folding, creasing but without deliberate applied force; and

FIG. **14** shows an improved control circuit of the type shown in FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will now be described by way of example only with reference to the previously identified drawings.

A position detector **101** constructed from fabric is shown in FIG. **1**. The detector has two electrically conducting fabric planes, in the form of a first plane **102** and a second plane **103**. The planes are separated from each other by means of a partially conductive central layer **104**. Partial conduction may be achieved in accordance with one or several of a plurality of arrangements, to be described later.

When force is applied to an area of the sensor, the two outer conducting planes **102** and **103** are brought into contact with central layer **104**. The central layer is partially conductive, and, therefore, electrical current may flow between planes **102** and **103** in the region where the force has been applied. It is then possible to identify properties relating to a mechanical interaction.